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THE ALCYONARIAN GENUS *BELLONELLA* FROM JAPAN, WITH DESCRIPTIONS OF TWO NEW SPECIES¹⁾

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With Plates IX-X and 8 Text-figures

The genus *Bellonella*, better known as *Nidalia*, is more commonly represented in the Japanese Alcyonarian fauna than elsewhere in the world, probably comprising about half of all the known species referable to the genus. Among Japanese zoologists it is generally called "Umi-itigo" which means the sea strawberry in Japanese, but not so familiar as in shallow-water alcyoniids, since it has been occasionally collected by dredging or trawling nets of fishermen from the depths of about 20-600 meters. Although never actually on shores, most of the species living in aquaria are vividly colored fascinating to anyone looked on for the first time.

The hitherto most comprehensive studies on this genus were published by KÜKENTHAL (1906a, b) who enumerated seven species from Japanese waters, all referring to the genus *Nidalia* in his belief that *Bellonella* GRAY (1862) is synonymous with *Nidalia* GRAY (1835). Further, NUTTING (1921) added two new species from the "Albatross" Expedition, one referring to *Nidalia* (*N. gracilis*), while the other to *Bellonella* (*B. flava*). Accordingly, about nine valid species are at present known from Japanese waters.

As to the validity of the genus *Bellonella*, I will discuss in detail in another paper (UTINOMI, MS.), with a revision of the related genera, since it seems that the genus *Nidalia* (Type species: *N. occidentalis* GRAY) is to be regarded as a member of the family Siphonogorgiidae in the sense of generally accepted classification.

The present paper was intended to describe in detail all the known and two hitherto undescribed species from Japanese waters at present available for study and to clarify the evolutionary relationships between them. Among the species hitherto recorded, the seven species described by KÜKENTHAL have been rediscovered, but not the two described by NUTTING. In making the key to all the known species from Japan and even from the world, unfortunately, the existing descriptions often did not allow to identify them properly and to compare with one another. In this respect, NUTTING's descriptions of the two Japanese species are still incomplete, especially as

1) Contributions from the Seto Marine Biological Laboratory, No. 302.

regards the anthocodial armature, thus leaving in suspense the status of both. I have accordingly postponed dealing with the regional species now not before me until these can be compared with the types of those described already by NUTTING.

In pursuing this work I am greatly indebted to many gentlemen of various institutions and universities who have collected or in care of specimens. Among them, my special thanks are due to Dr. H. HATTORI and staff members of the Biological Laboratory of the Imperial Household, and to Prof. D. MIYADI of the Zoological Institute of the Kyoto University. I am also indebted to the following for their kind cooperation for the loan or offer of pertinent specimens: Dr. I. TOMIYAMA, Marine Biological Station of Tokyo University, Misaki; Mr. M. IMAJIMA, Marine Biological Laboratory of Hokkaido Gakugei Daigaku, Sirigisinai; Miss S. OISHI, Fisheries Department, Prefectural University of Mie, Tu; Prof. T. KAMOHARA, Kochi University, Kochi; Mr. K. MORIKAWA, Ehime University, Matuyama; Mr. R. ISIBASI, Ozaki, Osaka Prefecture; Mr. M. OZAKI, Minabe, Wakayama Prefecture. All photographs in the plates were made by Mr. E. HARADA of our Laboratory.

The repositories of the specimens are abbreviated in text, unless otherwise specified, as follows:

I. B. L. — Biological Laboratory of the Imperial Household, Tokyo.

Z. I. K. U. — Zoological Institute, Kyoto University, Kyoto.

S. M. B. L. — Seto Marine Biological Laboratory, Sirahama.

Key to the Japanese species of *Bellonella* here described

1. Calyces of low, 8-lobed, rounded verruca; anthocodial armature formed of many narrow spicules. 2
1. Calyces tubular in form; anthocodial armature formed of a few large spicules. ... 6
2. Colony plump, somewhat conical, slightly bent, with short sterile stalk. 3
2. Colony tall, cylindrical, with rather long sterile stalk relatively to total height of the colony. 4
3. Colony not flattened; coenenchyme with large and long spindles. ... *B. rubra* BRUNDIN
3. Colony flattened in one plane; coenenchyme with small and rather compact spindle. *B. grandiflora* (KÜKENTHAL)
4. Colony smaller than 6 cm long; stalk narrower than capitulum but similarly colored. *B. unicolor* (KÜKENTHAL)
4. Colony grown to large size; capitulum and stalk usually of the same diameter, but differentiated in coloration. 5
5. Capitulum deeper in coloration than stalk; calyces thickly set on capitulum; neck zone devoid of spicules; calyx rind contains pink spinose spindles with branched warts. *B. rigida* PÜTTER
5. Capitulum deeper in coloration than stalk; calyces widely separated; neck devoid of spicules; calyx rind contains reddish, very small spindles, toge-

- ther with much longer, simply warted, colorless spindles under the superficial layer. *B. pellucida* (KÜKENTHAL)
5. Capitulum paler in coloration than stalk; calyces slightly separated (about 2 mm apart); polyps wholly devoid of spicules; all rind contains 8-radiate capstans with large round warts, while coenenchyme contains smaller capstans with stellate heads. *B. albiflora* n. sp.
6. Outer surface armed with small spindles, rather irregularly arranged; coenenchyme contains spindles similar to those of cortex; colony often branched, with variable coloration; calyces widely separated. *B. dofeini* (KÜKENTHAL)
6. Outer surface thickly armed with large spindles longitudinally arranged; coenenchyme almost lacking spicules; colony unbranched. 7
7. Cortical spicules 4-6 mm long; calyces widely separated; colony orangish yellow. *B. macrospina* (KÜKENTHAL)
7. Cortical spicules 2-3 mm long; calyces imbricated longitudinally; colony brownish white. *B. sibogae* n. sp.

Description of the Species

1. *Bellonella rubra* BRUNDIN, 1896

(Pl. IX, figs. 1-2 and Text-fig. 1)

Bellonella rubra BRUNDIN, 1896, p. 6, Pl. I, fig. 2 & Pl. II, fig. 2.—(Korea Strait; Tugaru Strait¹⁾)

Bellonella rubra PÜTTER, 1900, p. 447.—(No new record)

Nidalia rubra KÜKENTHAL, 1906a, p. 32; KÜKENTHAL, 1906b, p. 22, Pl. I, fig. 5 & Pl. V, figs. 29-30.—(Misaki, Sagami Bay)

Nidalia rubra NUTTING, 1921, p. 21.—(Albatross Sta. 4807, Cape Tsiuka, Bering Sea; Albatross Sta. 4815, Niigata Light, Sea of Japan)

? *Bellonella cinerea* BRUNDIN, 1896, p. 8, Pl. I, fig. 3 & Pl. II, fig. 3.—(Hirado Strait²⁾, northwest of Kyusyu)

? *Bellonella rubra* J. S. THOMSON, 1910, p. 554, Pl. II, fig. 13, Pl. III, fig. 21 & Pl. IV, fig. 43.—(South Africa, without exact locality)

? *Nidalia rubra* THOMSON and DEAN, 1931, p. 35, Pl. XXIII, fig. 6.—(Siboga Sta. 289, near Timor Island)

Japanese Name. Umi-itigo.

Material examined. Sagami Bay: 1) Ebine, off Nagai, 12 fms. June 16, 1956. 1 ex., 3 cm long (I.B.L. No. Coel. 570). 2) Samezima, at Hayama, depth unrecorded. Feb. 18, —. 4 ex., 2 cm, 2.6 cm, 3.6 cm and 4 cm long respectively (I.B.L. No. Coel. 46). 3) Samezima, at Hayama, depth unrecorded. July 6, 1929. 4 ex., 3.3 cm, 3.3 cm, 3.5 cm and 4 cm long respectively (I.B.L. No. Coel. 51).

Seto Inland Sea: 4) Gogosima, Ehime Prefecture, depth unrecorded. 1916. 1 ex., 7.5 cm long (Z.I.K.U.). 5) Southeast of Yasirozima, Yamaguti Prefecture. Aug. 6, 1939,

1) Originally misspelt as "Tsugar-Strasse".

2) Originally misspelt as "Hirudo-Strasse".

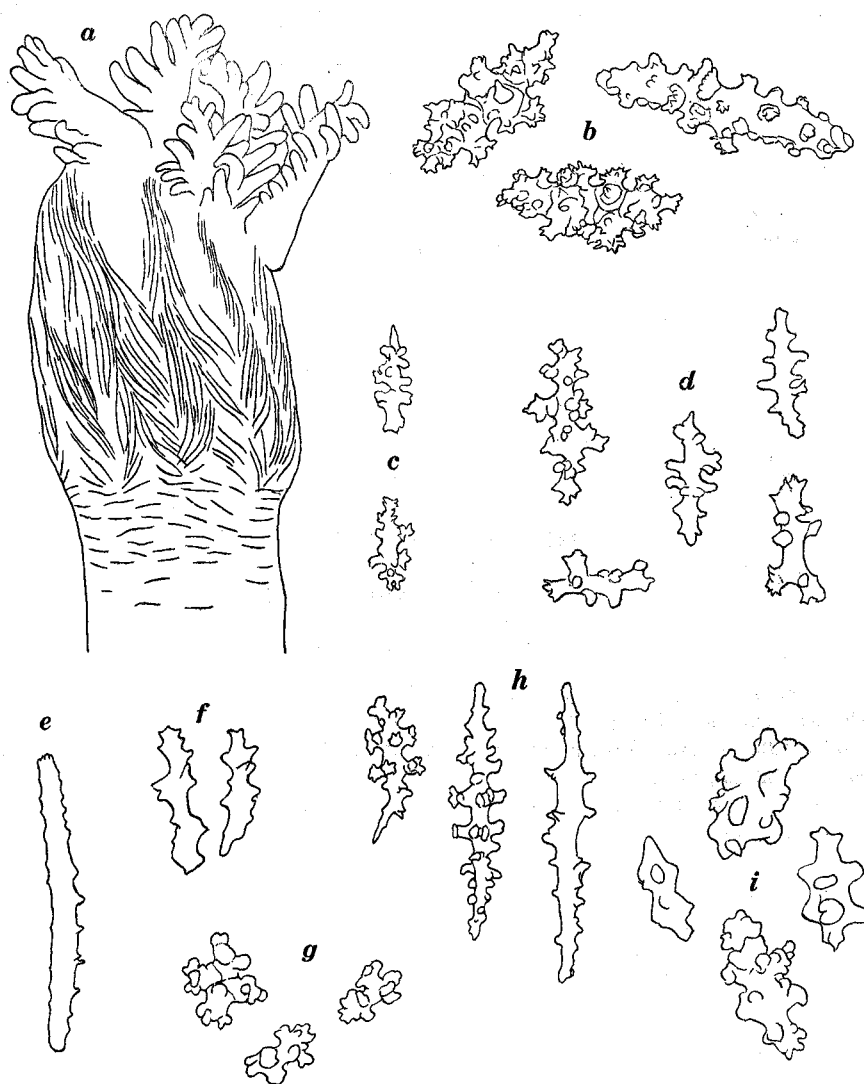


Fig. 1. *Bellonella rubra* BRUNDIN.

a-b, from a specimen from Sagami Bay (No. 570, I.B.L.).

c-d, from a specimen from off Yasirozima, Seto Inland Sea (E.U.).

e-i, from a specimen from Gogosima, Seto Inland Sea (K.U.).

a, Upper part of polyp; *b*, spicules from calyx wall; *c*, from calyx wall; *d*, from coenenchyme of stem; *e*, from anthocodia; *f*, from tentacles; *g*, from calyx wall; *h*, from coenenchyme of stem; *i*, from stalk cortex.

[*a*, $\times 27$; *b-i*, $\times 150$]

K. MORIKAWA coll. 1 ex., 6 cm long (Biological Institute, Ehime University).

Description. The colonies, represented by 11 specimens, are rather conical in form, slightly bent, ranging from 2 to 7.5 cm high and rigid in texture. In all of them, the stalk is invariably short but its length varies greatly, being from about 1/15 to 1/3 of the total height, when contracted. Sometimes it is only feebly developed, but always the calyces encircling the base of the capitulum extend downwards, forming more or less distinct longitudinal ridges.

When the polyps retracted, the calyces are thickly set and regularly arranged with the intervals of about 2 mm. These are low verruca, about 1.5–2 mm in diameter and distinctly 8-lobed at the top. Between the calyces an athecate hydroid *Hydrichthella epigorgia* STECHOW often occurs densely, as in *B. rigida*.

The polyps, when extended, reach about 5 mm in length. Tentacles are about 1 mm long and bear 7–8 finger-like pinnules on each side, and a double row of about 0.12 mm long, flattened spiny rods arranged rather transversely on the back. The anthocodial armature consists of 8 double rows of steeply converging numerous spindles which are all slender in size, 0.19–0.38 mm long, 0.017–0.023 mm wide, feebly warted and bluntly ended. Below these the spicules are transversely arranged, not in the form of well-differentiated collaret, becoming sparsely into the eight interseptal tracts of the neck zone down to the calycular margin.

The calycular spicules are typical spindles covered by large compact warts, often forming transverse belts. In a specimen from Sagami Bay (I.B.L. No. 570), they measure 0.08×0.05 mm, 0.14×0.07 mm and 0.17×0.05 mm. In the stalk cortex, the spicules are similar in form, but their warts are not so compact but roundly obliterated, measuring 0.12×0.05 mm and 0.14×0.05 mm. The interior of the stem is densely filled with similar but longer, more slender spindles with widely separated high warts, usually pointed at both ends, rarely at one end alone. They measure 0.14×0.05 mm, 0.22×0.05 mm and 0.27×0.05 mm.

Color. The colony is uniformly deep carmin red, the capitulum and stalk being similar in color. All spicules are red.

Remarks. *B. cinerea* BRUNDIN having colorless spicules was merged by KÜKEN-THAL (1906) into *B. rubra* on account of the unreliability of color in specimens preserved in alcohol. However, it is very problematic that the original color of spicules is retained for a long time in one specimen, while it may have been discolored in other specimens, even if they were simultaneously preserved. Actually THOMSON and DEAN (1931) referred two small specimens with colorless or dull yellowish gray spicules among the "Siboga" collections to *B. rubra* "with some hesitancy". The spicules of "Siboga" specimens figured by them (cf. Pl. XXIII, fig. 6) do not exactly agree with those of *B. rubra* or *B. cinerea* in the slenderness and small size. It is probably not the same as either of both Japanese species.

The same may be said for the South African specimens of "*Bellonella rubra*" described and figured by J. S. THOMSON (1910). The spicules more approach those

of *B. rubra* than the above-cited East Indian specimens show. However, he states that "When contracted, the polyps appear as yellowish and reddish circular areas (calyces) on the surface of the deep red coenenchyma." and further "None of the polyps were in a completely expanded condition." Such conditions are by no means observed in our Japanese specimens. However, without reference to type material of both specimens, this is another question that must go unanswered.

2. *Bellonella grandiflora* (KÜKENTHAL), 1906

(Pl. IX, figs. 5-6 and Text-fig. 2)

Nidalia grandiflora KÜKENTHAL, 1906a, p. 34; KÜKENTHAL, 1906b, p. 24, Pl. I, figs. 6-7.—
(Misaki, Sagami Bay)

Japanese Name. Ōbana-umiitigo.

Material examined. Sagami Bay: 1) Misaki. Nov. 1919, the late Prof. Iwaji IKEDA coll. 4 ex. (Z.I.K.U.). 2) Kasazima, shallow water. Apr. 17, 1949. 1 ex. (I.B.L. No. Coel. 298).

Description. All the specimens are very large, plump, club-shaped in form, distinctly curved to one side and strongly flattened in one plane. The basal sterile stalk is short and narrower than the expanded capitulum. The measurements of colonies in mm are as follows:

	Misaki	"	"	"	Kasazima
Total height	52	86	102	103	90
Length of stalk	8	18	10	25	10
Width of capitulum	30	24	30	35	53
Thickness of capitulum	23	19	26	27	45

The coloration and spiculation, as originally described, resemble closely those of *B. rubra*, but the polyps are extremely large, extending more than 1 cm in length and up to 2.5 mm in diameter of the head. The tentacles bear usually 7 pinnules on either side.

The anthocodial spicules are lengthwise arranged in 8 double rows, becoming downwards to be transversely set, smaller in size, paler in color and less densely distributed, so that the neck zone is transparent and appears colorless. The calyces are about 2.5-3 mm in diameter at the base and 1-2 mm high, and their walls contain typical spindles with simple or compact warts, about 0.07×0.035 mm, 0.11×0.04 mm and 0.13×0.04 mm. In the stalk cortex as well as in the coenenchyme are smaller spicules with few warts (less than 0.09 mm in length) which tend to be 8-radiates or capstans: besides, larger spindles not exceeding 0.18 mm in length with high warts are also contained.

Color. The colony is uniformly deep carmin red, but the polyps are transparent white in the neck zone due to the sparseness of red spicules.

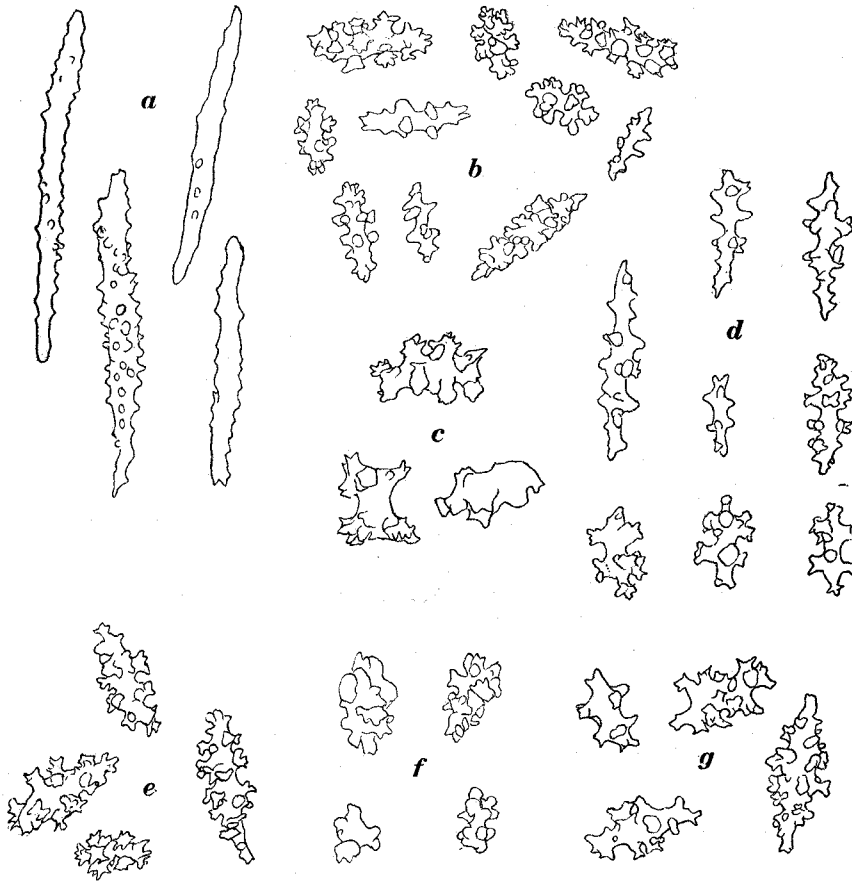


Fig. 2. *Bellonella grandiflora* (KÜKENTHAL) from Misaki, Sagami Bay (Z.I.K.U.).

a-d, from a large specimen, 103 mm in total height.

e-g, from a small specimen, 52 mm in total height.

a, Spicules from anthocodia; b, from calyx wall; c, from stalk cortex;

d, from coenenchyme of stem; e, from calyx wall; f, from stalk cortex;

g, from coenenchyme of stem.

[All figs. $\times 150$]

3. *Bellonella unicolor* (KÜKENTHAL), 1906

(Pl. IX, figs. 3-4 and Text-figs. 3-4)

Nidalia unicolor KÜKENTHAL, 1906a, p. 34; KÜKENTHAL, 1906b, p. 26, Pl. I, fig. 4.—(Hakodate, 73 m)

Japanese Name. Hime-umiitigo (nom. nov.).

Material examined. Tugaru Strait: 1) Off Siriyazaki, northernmost cape of Honsyu, 180 m. Feb. 14, 1956, M. IMAJIMA coll. 1 ex. (Marine Biological Laboratory, Sirigisinai, Hokkaido).

Sagami Bay : 2) Misaki. Date unlabelled. 1 ex. (Z.I.K.U.). 3) West of Kamegisyô, 52-54 m. Feb. 10, 1957. 1 ex. (I.B.L. No. Coel. 620). 4) West of Kamegisyô, 47-52 m. Feb. 10, 1957. 1 ex. (I.B.L. No. Coel. 623).

Description. The colonies are rather small for the genus, Indian club-like in form,

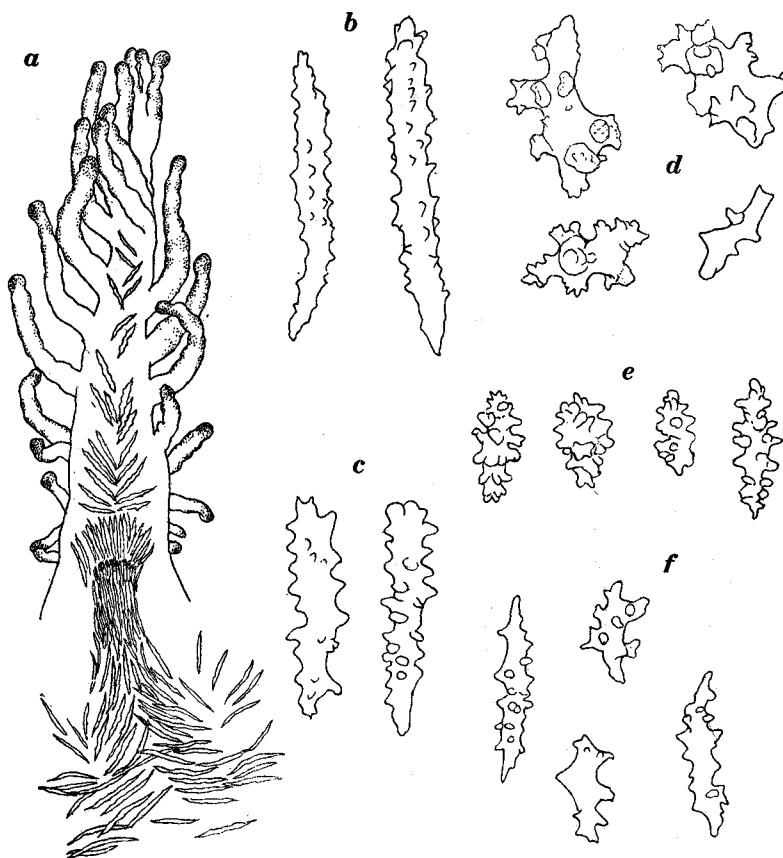


Fig. 3. *Bellonella unicolor* (KÜKENTHAL) from off Siriyazaki, Tuguru Strait.

a, Tentacle, showing the arrangement of spicules, continued from the anthocodial point; *b*, spicules from anthocodia; *c*, from tentacles; *d*, from stalk cortex; *e*, from calyx wall; *f*, from coenenchyme of stalk.

[*a*, $\times 33$; *b-f*, $\times 150$]

with a shrunken stalk expanded at base. The consistency is rather rigid. The coloration is rather uniform as the name means, but variable in different colonies. The measurements (in mm) and coloration of all specimens here examined are shown as follows :

	Off Siriyazaki	Misaki	Kamegisyo (No. 620)	" (No. 623)
Total height	60	42	36	21
Length of stalk	20	15	10	10
Maximum diameter	12	8	7	9
Color	salmon pink	pinkish white	dark red	dark red

The capitulum is almost similar in size at the upper and lower levels and covered with polypal calyces, separated by intervals of about 2-3 mm. The calyces are relatively high, about 1-3 mm long, decreasing in size distally. The polyps extend about 3-4 mm beyond the calycular margin. The neck zone is devoid of spicules. In the



Fig. 4. *Bellonella unicolor* (KÜKENTHAL) from Sagami Bay.

a-e, from a specimen from west of Kamegisyo (No. 620, I.B.L.).

f-h, from a specimen from Misaki (Z.I.K.U.).

a, Two tentacles; *b*, spicules from anthocodia; *c*, from coenenchyme of stem; *d*, from calyx wall; *e*, from stalk cortex; *f*, from anthocodia; *g*, from calyx wall; *h*, from coenenchyme of capitulum.

[*a*, $\times 27$; *b-h*, $\times 150$]

anthocodial part, strongly warted spindles are arranged transversely, forming an indistinct collaret below, and then assume an *en chevron* arrangement, becoming parallel, converging and extending up to the tentacle bases, where they are ended distally in a somewhat fan-like manner. These spicules are about 0.26–0.35 mm in length and 0.03 mm wide, and those set in the distal part of points are often thickened at one end. The tentacles reach about 3 mm in length and bear on each side about 13, somewhat clavate, long pinnules. Along the tentacle backs for about two-thirds of their lengths, a few flattened warty rods, about 0.18 mm long and 0.03 mm wide, are arranged in a downwardly converging double row. The distal part of the tentacle and all pinnules are free of spicules.

The calyces over the capitulum contain small spindles with thickly set simple warts, measuring about 0.05–0.2 mm long and 0.035 mm wide. The stalk rind contains large, irregular-shaped spicules with large warts that appear to be derived from the spindle type. Their sizes largely exceed those of the calycular rind, as in the measurements: 0.09×0.05 mm, 0.1×0.05 mm, 0.12×0.07 mm and 0.26×0.09 mm. In the coenenchyme there are usually spiny spindles with conical warts, measuring about 0.14×0.07 mm, 0.17×0.05 mm, 0.26×0.05 mm and 0.35×0.05 mm.

Color. As stated above, the coloring of spicules is not constant within species. In the two specimens from Sagami Bay, the capitulum and stalk are uniformly dark red as in the type specimens, whereas in one from Misaki and one from off Siriyazaki (near the type locality) they are much paler. In any of them, the spicules of tentacles only are invariably colorless.

Remarks. The specimens described and figured by J. S. THOMSON (1910) from South Africa under the name "*Metalcyonium clavatum* PFEFFER" seem to be a nearest akin to this species, although he mentions that this is not a *Bellonella* or *Nidalia*. The difference between *Bellonella* and *Metalcyonium* many of which have been recorded from the Subantarctic region is so vague that only by a complete revision can their status be decided.

4. *Bellonella rigida* PÜTTER, 1900

(Pl. X, fig. 9)

Bellonella rigida PÜTTER, 1900, p. 448, Pl. XXIX, fig. 1.—(Nagasaki)

Eleutherobia japonica PÜTTER, 1900, p. 449, Pl. XXIX, figs. 2 & 11.—(Japan, without exact locality)

Nidalia rigida KÜKENTHAL, 1906a, p. 33; KÜKENTHAL, 1906b, p. 29.—(near Enosima, Sagami Bay; West of Formosa, 31 fms.)

Nidalia rigida UTINOMI, 1954, p. 43.—(Seto, 20–30 m; Kii Strait)

Japanese Name. Bô-umiitigo.

Material examined. Sagami Bay: 1) Off Hayama, taken by a Danish seine. Apr. 17, 1949. 1 ex., 9.8 cm long (I.B.L. No. Coel. 299). 2) Off Hayama, taken by a Danish seine. Mar. 24, 1951. 2 ex., 13 cm & 16 cm long (I.B.L. No. Coel. 368). 3) Off

Hayama, taken by a Danish seine. Apr. 24, 1951, 1 ex., 18 cm long (I.B.L. No. Coel. 372). 4) Off Hayama, taken by a Danish seine. Apr. 25, 1951. 2 ex., 10.5 cm & 18 cm long (I.B.L. No. Coel. 374). 5) Off Hayama, taken by a Danish seine. Jan. 14, 1957. 1 ex., 13 cm long, abnormally branched (I.B.L. No. Coel. 609).

Ise Bay: 6) Aritaki, Ise City. Aug. 24, 1950. 2 ex., 7 cm & 15 cm long (Fisheries Department, Prefectural University of Mie, Tu).

Kii Strait: 7) Off Minabe, 100-200 m. Mar. 1950, M. OZAKI coll. 1 ex., 7.8 cm long (S.M.B.L.).

Supplementary Description. This species was already described in detail on a specimen from Seto (UTINOMI, 1954), so that it might be needless to reiterate here. But some notes about these new materials are added as a supplement.

All of the specimens here examined are relatively large, being 7-18 cm in total height, like the types of this species (i.e. 72 mm for *Bellonella rigida* and 162 mm for *Eleutherobia japonica*, after PÜTTER). In most of the specimens, the base is not expanded but roundly ended with no hint of being attached to any solid substratum. The sterile stalk is relatively long, occupying about 1/6 to 1/3 of the total height, as shown in the following measurements (in mm):

	Off Hayama	"	"	"	Aritaki
Total height	98	130	160	180	150
Length of stalk	25	40	60	70	25
Maximum diameter	14	20	16	10	20

The consistency of the colony is rather rigid in smaller forms, while soft in larger forms. The calyces are scattered irregularly on all sides of the capitulum with intervals of about 2-3.5 mm, and the interspaces between them usually covered by an athecate hydroid *Hydrichthella epigorgia* forming a network of stolons.

Color. The capitulum and the basal parts of calyces, together with the polyp spicules, are bright red, while the tips of calyces are dirty white or yellowish. The stalk, especially in its basal half, is also dirty white.

5. *Bellonella pellucida* (KÜKENTHAL), 1906

(Pl. X, fig. 7 and Text-fig. 5)

Nidalia pellucida KÜKENTHAL, 1906a, p. 35; KÜKENTHAL, 1906b, p. 27, Pl. II, fig. 10.—(Sagami Bay, 50-100 m and between Ito and Hatusima)

Japanese Name. Ryûgû-umiitigo (nom. nov.).

Material examined. Sagami Bay: 1) Issiki, taken by a Danish seine. Feb. 22, 1930. 1 ex., 15 cm long (I.B.L. No. Coel. 28). 2) Misaki, depth and date unlabelled. 3 ex., 5.8 cm, 7.5 cm & 8 cm long respectively (Z.I.K.U.).

Description. The largest colony (No. 28), about 15 cm in length, is very flabby but not transparent. The stalk, arising from a membranous basal expansion, is transversely wrinkled, much shrunken, and its length is less than one-third of the total

height. Namely, the capitulum is 115 mm and the stalk 30 mm in length, and about 15-17 mm in diameter of the capitulum.

The calyces are rather longitudinally arranged at long distances from one another



Fig. 5. *Bellonella pellucida* (KÜENTHAL) from Issiki, Hayama, Sagami Bay (No. 28, I.B.L.).

a, Lateral view of tentacle, showing the arrangement of spicules (Red colored spicules being hatched, while colorless spicules not hatched); *b*, spicules from anthocodia; *c*, from stomodaeal wall; *d*, from outer layer of cortex, red in color; *e*, from inner layer of cortex, colorless; *f*, from stalk cortex; *g*, from bases of pinnules; *h*, from tentacles; *i*, from coenenchyme of capitulum.

[*a*, $\times 53$; *b-i*, $\times 150$]

(about 4 mm apart upwards, while about 6 mm apart downwards), being longitudinally grooved between them. They are about 1.5–2.0 mm across and relatively low in height. The polyps project considerably, extending about 10 mm beyond the tip of the calyces. They are wholly transparent owing to the total absence of spicules in the neck zone.

The anthocodial portion is, as usual, beset with the eight points of slender spindles arranged *en chevron* above the transverse collaret rows of shorter spindles. These anthocodial spicules are very feebly warted or almost smooth, brick red by reflected light and about 0.26–0.56 mm in length. They continue up to the longitudinal rows of colorless spicules along the tentacle backs. Thereafter the spicules are somewhat flattened and sharply pointed at both ends, about 0.26–0.35 mm long. In addition, a few bent needle-like spicules, about 0.09–0.12 mm long, surround the bases of the pinnules which number 13–14 on each side and are pointed distally. The stomodaeal wall is also provided with similar flattened spindles, about 0.1–0.16 mm long, transversely placed.

The spiculation of the cortex of the capitulum, as well as the calyces, is peculiar. The outer surface is covered with very small, red-colored, capstan-like spindle bearing compound warts, about 0.05×0.035 mm \sim 0.07×0.05 mm in size; below these are densely distributed the much longer, colorless, slender spindles having high single warts, about 0.2×0.017 mm \sim 0.4×0.035 mm in size. At the tips of the calyces, however, these spicules are closely mingled and not differentiated in coloration, thus the tip appears to be colorless.

In the cortex of the stalk too, there are two types of spindles. But here the spicules are larger, stouter and all colorless at all. They measure 0.26×0.07 mm and 0.35×0.05 mm in a large form, and 0.09×0.033 mm and 0.09×0.035 mm in a small form. In the coenenchyme, almost similar but weakly warted, colorless spindles are irregularly placed; they are 0.19×0.035 mm, 0.25×0.05 mm and 0.3×0.35 mm in measurements.

Color. As clear from the above description, the capitulum, together with the anthocodia, is brick red or bright red, while the stalk is dirty white at all. The tip of the calyces and the tentacles are colorless.

Remarks. Superficially this species is closely allied to the preceding *B. rigida*, but may be distinguished by its more distant arrangement of calyces and by the peculiar spiculation. Constrictions of the stem, if present, may depend upon the considerable softness of the constitution, and thus cannot be regarded as the diagnostic characteristics of this species.

6. *Bellonella albiflora* n. sp.

(Pl. X, fig. 8 and Text-fig. 6)

Japanese Name. Sirobana-umitigo (nom. nov.).

Holotype. Sagami Bay: West of Kamegisyo, 45 m. Mar. 17, 1953. 1 ex. (I.B.L. No. Coel. 632).

Description. The single specimen is a very beautiful cylindrical colony, measuring ca. 90 mm in length and 12 mm in maximum diameter. The stalk is only 10 mm long, its basal portion being unfortunately damaged.

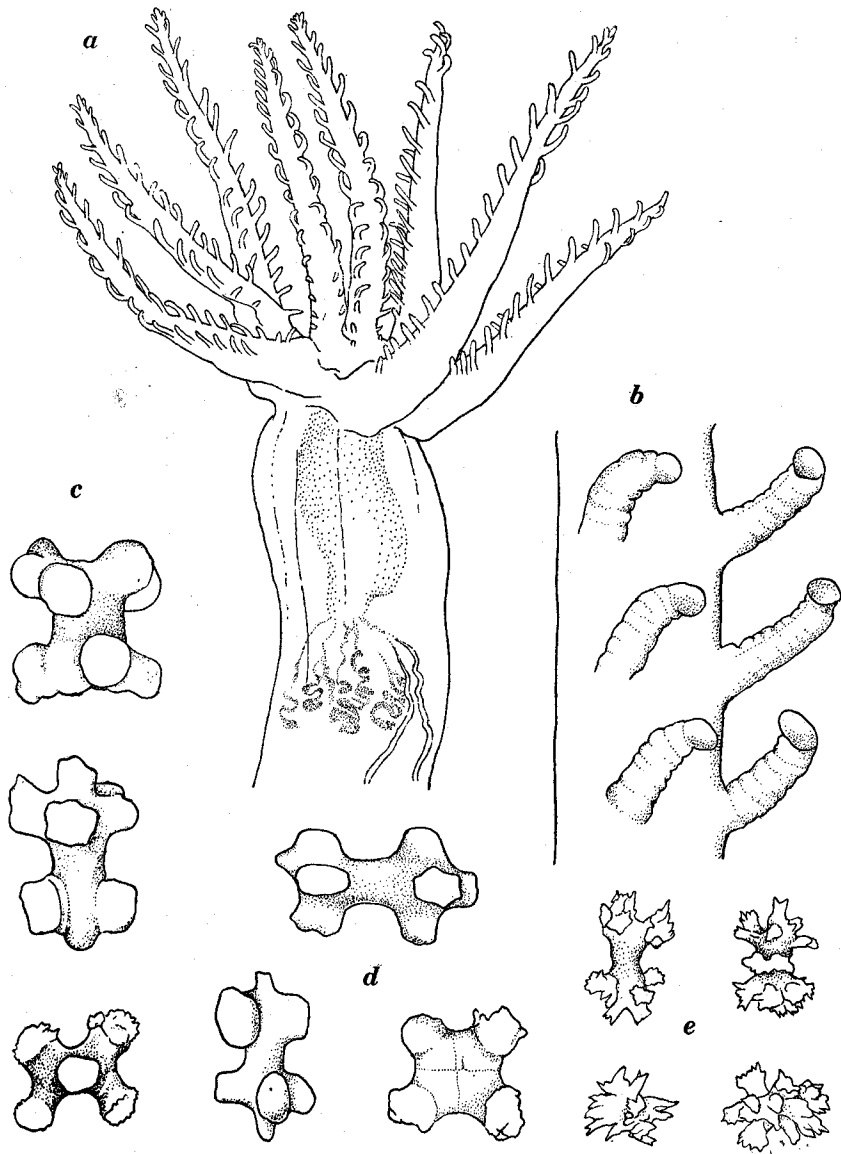


Fig. 6. *Bellonella albiflora* n. sp., holotype (I.B.L. No. 632).

a, Upper part of polyp; *b*, part of tentacle; *c*, spicules from stalk cortex (basal one in polar view); *d*, from calyx wall (right one at base is a cross); *e*, from coenenchyme.

[*a*, $\times 12$; *b*, $\times 67$; *c-e*, $\times 415$]

All the polyps over the capitulum are fully extended beyond the slightly raised calyces which are irregularly distributed by intervals of about 1 mm. Each polyp is transparent and lacks spicules at all, reaching about 10 mm in length (excluding tentacles) and 2 mm in diameter. Tentacles, when fully extended, are very long up to about 5 mm and bear about 18 long pinnules equidistantly on each side. The pinnules are somewhat clavate in shape, terminating to a globose thickening; the longest one located in the middle measures about 0.3 mm long.

All the spicules present only in the stem are very small capstan types. In the stalk cortex, there are red 8-radiates with prominent large warts, measuring 0.05×0.038 mm, 0.056×0.033 mm and 0.056×0.038 mm. In the cortex of the capitulum are similar 8-radiates and crosses, but colored pale red, measuring 0.047×0.028 mm, 0.047×0.038 mm and 0.056×0.039 mm. In the interior of both portions are brick red capstans with star-like headed warts of smaller size, measuring 0.03×0.028 mm and 0.037×0.028 mm.

Color. The capitulum is pale pink or salmon pink, becoming darker towards the stalk where it is bright red. All polyps are transparent white.

Remarks. This very distinct species is unique for the genus in the occurrence of spicules of the capstan type and in the total absence of spicules in the polyps.

7. *Bellonella dofleini* (KÜKENTHAL), 1906

(Pl. X, fig. 12)

Nidalia dofleini, KÜKENTHAL, 1906a, p. 35; KÜKENTHAL, 1906b, p. 27, Pl. II, figs. 8-9.—(Misaki, 150 m)

Nidalia dofleini THOMSON and DEAN, 1931, p. 34, Pl. V, fig. 5 & Pl. XXV, fig. 5.—(*Siboga* Sta. 49a, $8^{\circ}23.5'$ S, $119^{\circ}4.6'$ E, 69 m); UTINOMI, 1954, p. 45, fig. 2.—(Off Minabe, Kii Strait, 100-200 m; Tosa Bay)

Japanese Name. Eda-umiitigo.

Material examined. Kii Strait: 1) Off Minabe, 100-200 m. Jan. 22, 1957, M. OZAKI coll. 2 ex. (S.M.B.L.).

Tosa Bay: 2) Off Mimase, 100-200 m. 1953, T. KAMOHARA coll. 27 ex., 18-50 mm long (S.M.B.L.).

Supplementary Description. This species is small, rather stiff, brittle, and often loosely branched. The calyces are rather sparsely distributed but mostly clustered at terminal ends of stem and branches. Each of them is rather high but wholly attached by its adcauline side to the surface of the stem, and the top is rounded and distinctly 8-lobed.

The spicules in the cortex and coenenchyme are predominantly small warty spindles tapering to one or both ends, less than 0.4 mm in length. In the cortex of the capitulum, the spicules are usually differentiated into two layers, though thickly set, shorter spindles about 0.05-0.15 mm long in the outer layer and longer ones about 0.09-0.37 mm long in the inner layer. In the stalk cortex, the spiculation is not so differentiated,

containing more robust spindles with 4-warted girdles, about 0.1–0.17 mm long and 0.05×0.04 mm, 0.2×0.05 mm and 0.25×0.05 mm.

The anthocodial armature shows 6–7 pairs of curved, thorny spindles *en chevron* in eight points with about 7 transverse rows of thorny spindles below; they are about 0.44–0.6 mm long and 0.03 mm wide. The neck zone bears tiny rodlets, about 0.09 mm long, arranged transversely. The tentacle bears warty rods, about 0.1–0.2 mm long by 0.03 mm wide.

Color. The coloration varies greatly, being dirty white, pale yellow, pink, light orange or pinkish red, etc. The tips of the calyces are mostly paler, brighter or darker than the rest.

8. *Bellonella macrospina* (KÜKENTHAL), 1906

(Pl. X, fig. 10 and Text-fig. 7)

Nidalia macrospina KÜKENTHAL, 1906a, p. 34; KÜKENTHAL, 1906b, p. 30, Pl. II, figs. 11–12.—
(Entrance to Tokyo Bay, 600 m)

Nec *Nidalia macrospina* THOMSON and DEAN, 1931, p. 35, Pl. VIII, fig. 7.

Japanese Name. Ôtoge-umiitigo (nom. nov.).

Material examined. Sagami Bay: 1) Kadone, Off Hayama, 100 m. Mar. 21, 1952. 2 ex., 4.2 cm and 5.4 cm in length, attached to a dead shell of *Glycymeris imperialis* KURODA respectively (I.B.L. No. Coel. 433; S.M.B.L.). 2) Kadone, off Hayama, 110 m. Feb. 2, 1956. 1 ex., 5 cm long (I.B.L. No. Coel. 540). 3) Syuragane, off Hayama, 120 m. Apr. 13, 1956. 1 ex., 4 cm long, on a pebble (I.B.L. No. Coel. 558).

Tosa Bay: 4) Off Mimase, 100–200 m. 1953, T. KAMOHARA coll. 2 ex., 4.2 cm & 4.5 cm long respectively (S.M.B.L.).

Description. The specimens are more or less slender, unbranched, erect colonies less than 5.4 cm in length, arising from a flattened basal expansion. Larger ones are somewhat plump in the lower portion, as shown in the following measurements of No. 433 from Sagami Bay, on which the following description of the spiculation is based. The sterile stalk is about 10 mm in length and 8 mm in diameter, while the polypiferous capitulum is about 44 mm in length and has a maximum diameter of 10 mm at its lowest part.

The calyces are arranged rather spirally around the capitulum, becoming sparse upwards and clustered at the terminal end. Each of them is tubular in form and projects obliquely upwards, adhering by its whole adcauline side to the stem. The top of the calyces is, when closed, not 8-lobed but truncated as in most Siphonogorgiids. Its diameter reaches about 2 mm at the top. Therefore, the calyces are placed from one another at wide intervals (about 6–8 mm) along the longitudinal axis.

In the cortex of the stem, together with the calyces, there are a number of large spicules lying longitudinally close together, so that the entire surface acquires a rigid brittle consistency. The spicules are exclusively long plump spindles covered by

numerous small warts; they measure in the stalk about 3–5 mm in length and 0.3 mm in width, though shorter ones more numerous. In the calyx wall, they measure 0.8×0.09 mm, 1.5×0.12 mm and 2×0.8 mm. The interior of the stem is mostly devoid of spicules; but if present, they are almost smooth spindles, measuring 0.18×0.025 mm, 0.28×0.025 mm and 1.0×0.1 mm.

The polyps retracted into the calyces bear spicules in the anthocodial part and tentacles alone. The anthocodial armature consists of a distinct collaret of about 6 transverse rows of relatively large spindles and eight points each consisting of more

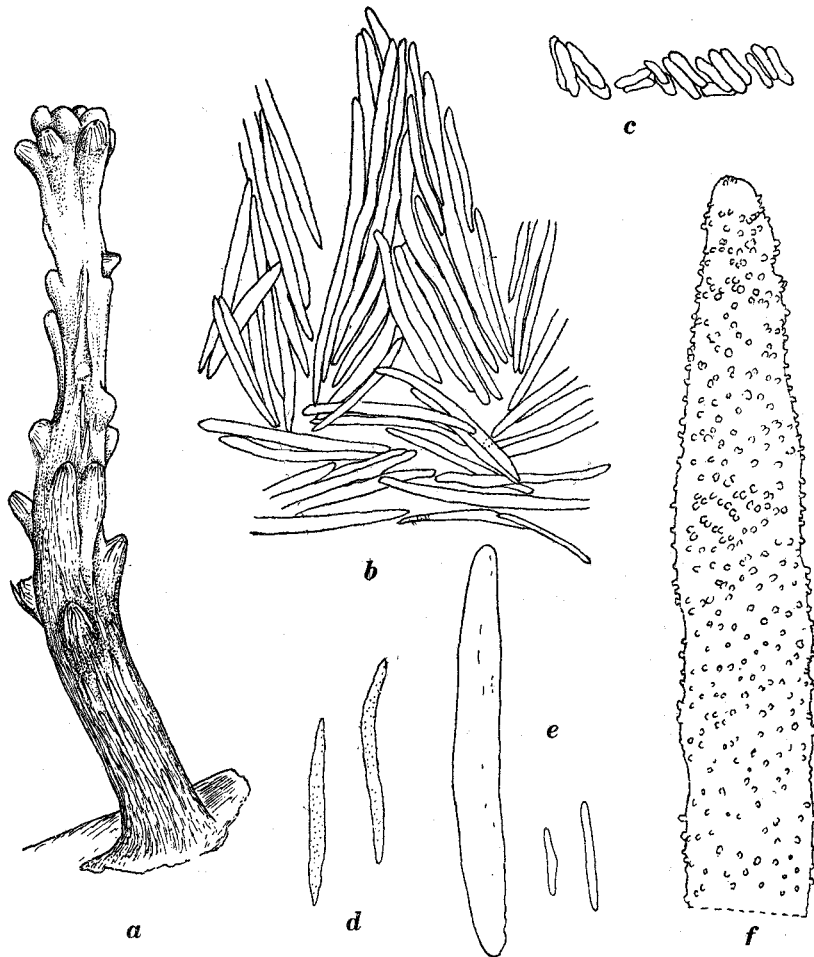


Fig. 7. *Bellonella macrospina* (KÜKENTHAL).

a, Specimen from off Hayama, Sagami Bay (No. 540, I.B.L.).

b-f, from specimen from off Nagai, Sagami Bay (No. 433, I.B.L.).

a, Animal; *b*, anthocodial armature; *c*, spicules from tentacles; *d*, from anthocodia; *e*, from coenenchyme; *f*, from stalk cortex (part).

[*a*, $\times 2$; *b-c*, $\times 67$; *d-f*, $\times 53$]

than 7 pairs of similar spindles. These spindles are very finely warted and range between 0.26×0.26 mm $\sim 0.4 \times 0.05$ mm. The tentacles have flat rodlets, about 0.09×0.02 mm. The number of pinnules could not be counted.

Color. Pinkish cinnamon to apricot orange. Tip of calyces and anthocodiae are tinged with brighter orange, when the rest is yellowish in color.

Remarks. As already noticed by KÜKENTHAL (1906b) and THOMSON and SIMPSON (1909), this species, as well as the next *B. sibogae* n. sp., bears a strong resemblance to a certain Siphonogorgiid in spiculation and in form of the colony. Indeed, slender colonies such as two taken from Tosa Bay, showing less than 5 mm in diameter, may be often misled as an unbranched *Siphonogorgia*-like colony.

9. *Bellonella sibogae* n. sp.

(Pl. X, fig. 11 and Text-fig. 8)

Nidalia macrospina THOMSON and DEAN, 1931, p. 35, Pl. VIII, fig. 7 (Nec KÜKENTHAL, 1906).
(*Siboga* Sta. 251, $5^{\circ}28.4'$ S, $132^{\circ}0.2'$ E, 204 m)

Japanese Name. Tosa-umiitigo (nom. nov.).

Holotype. Tosa Bay: Off Mimase, 100–200 m. 1953, T. KAMOHARA coll. 1 ex. (S.M.B.L. Type No. 166).

Description. A single specimen, 7 cm in height with a basal width of 7 mm, consists of for the most part the polypiferous capitulum, and the sterile stalk is very short, only 12 mm in length. It is unbranched, cylindrical and slightly curved, tapering gradually upwards. The consistency of the colony is more stiff and brittle than in the preceding *B. macrospina*.

The calyces are very large, stout, tubular in form, and heavily armoured with large spicules. These tubular calyces are arranged close together, somewhat spirally around the stem and their distal portions project freely beyond the stem proper as in many of branched Siphonogorgiids. The largest one, when isolated, is thus tubular, expanded towards the top, measuring about 7 mm in height and about 2.5 mm in diameter at the top. The distance between the tops of adjoining calyces is about 3–4 mm *in situ*.

The polyps were completely retracted into the calyces, thus the actual size as well as shape could not be examined. The anthocodial armature consists of a distinct collaret of about 3 transverse rows, and points formed by 3–4 pairs of large spindles *en chevron*. These spindles are finely warted and bluntly ended, measuring 0.45×0.05 mm, 0.5×0.035 mm and 0.9×0.08 mm. On the tentacle backs rather robust, not flattened, rods are densely placed; they are between 0.3×0.05 mm and 0.1×0.018 mm, decreasing distally in size. Towards the bases of pinnules a few feebly warted rodlets, about 0.03 – 0.05 mm long and 0.008 mm wide, are scattered.

Entire surface of the stem and calyces is covered with large, close-fitting, heavily warted spindles, measuring about 1×0.1 mm, 2×0.23 mm, 2.35×0.23 mm, 2.8×0.3 mm

and 3×0.3 mm. The coenenchyme apparently lacks spicules at all.

Color. Light yellowish brown, becoming paler towards the tops of calyces. All spicules colorless.

Remarks. A specimen collected by the "Siboga" Expedition which was identified by THOMSON and DEAN (1931) as *Nidalia macrospina* KÜENTHAL is beyond doubt referable to the present new species. So the above name is here proposed.

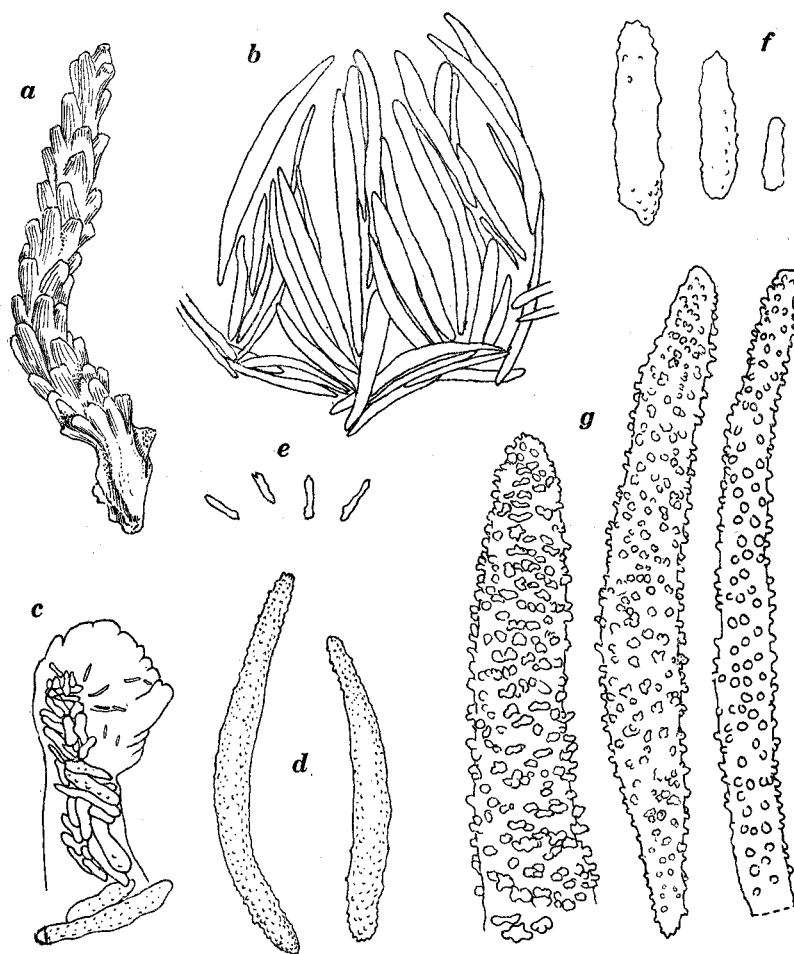


Fig. 8. *Bellonella sibogae* n. sp., holotype (Type No. 166, S.M.B.L.).

a, Holotype; *b*, anthocodial armature; *c*, tentacle showing the arrangement of spicules; *d*, spicules from anthocodial point; *e*, from pinnule bases; *f*, from tentacles; *g*, from stalk cortex and calyx wall.

[*a*, $\times 1$; *b-c*, $\times 33$; *g*, $\times 53$; *e-f*, $\times 97$]

A Note on the Evolution of Species Within the Genus

In describing the various species of *Bellonella* from Japanese waters and considering the relationships between them, I have arrived at the same conclusion as discussed by SHERRIFFS (1922) for the genus *Dendronephthya* (Nephtheidae) and also by CHALMERS (1929) for the genus *Siphonogorgia* (Siphonogorgiidae, or Nidaliidae as I will propose). The outstanding features which show the evolutionary relationship between the species within the genus and to other allied genera or groups are the retractility of the polyps, the anthocodial armature, the form of the anthosteles or calyces, and spicule types; in addition to these, the configuration of coenenchymes regarding the arrangement and abundance of spicules should be sometimes taken into account.

Within the Alcyoniidae, in most of the genera like *Alcyonium* and *Anthomastus* having large retractile polyps, the anthocodiae are heavily armoured, while in some aberrant (or specialized) forms the polyps only lack spicules completely. In this respect it is interesting to trace a transition between the species, suggesting an evolutionary trend within the genus *Bellonella*. The lengthwise *en chevron* arrangement of a large number of small spicules in the points as is often found in most Stoloniferans like *Clavularia*, is probably viewed as an indication of a primitive condition. Similarly, at their bases the spicules become to arrange more transversely, continuing down to the anthostele, often uninterruptedly in the retroversible neck zone, but in the most primitive condition they do not form any distinct crown or collaret rows (cf. Fig. 1, *a*). Further development of various modifications as representing evolutionary progression is probably shown by: (1) reduction of the number of spicules in the points, (2) formation of the distinct transverse rows in the collaret, (3) increasing in the size of all anthocodial spicules, and (4) reduction or elimination of spicules in the neck zone. In the systematic account given above, the species are arranged in order of the evolutionary trend.

Although such modifications are the universal tendency, the complete reduction of spicules in the polyps as in one example of the genus (*B. albiflora*) and in some aberrant forms of other Alcyoniids is probably a specialized feature and not indicative of more evolved forms in the main trend of evolution, that is another question that must be answered from different standpoint.

Mention must also be made of the structure of the non-retractile anthosteles and the main trunk of the colonies. In most of the species within the genus, like other Alcyoniids, the anthosteles forming the calyces into which the anthocodiae can be retracted are pronounced as a low mound, 8-lobed at the top, and thick-walled by virtue of dense spiculation. In more evolved forms such as *B. macrospina* (cf. Fig. 7, *a*) and *B. sibogae* (cf. Fig. 8, *a*), they develop to project freely as tubular forms and to be protected by a thick outer covering of larger spicules which continue from the cortical layer of the capitulum, and the tops of calyces appear to be rather truncated and not

8-lobed. In a peculiar form *B. dofleini* only (cf. UTINOMI, 1954, Fig. 2, *a-b*), however, the calyces tend to become tubular, but retain certain primitive features, being 8-lobed at the top and less spiculated. In other respects, especially as regards the anthocodial armature, the polyps are rather highly specialized. This species presents thus an interesting transitional stage from the primitive forms having numerous small spicules in the anthocodiae to the evolved forms having smaller number of large spicules. Branching seems to have arisen independently for this genus.

In the more primitive forms of *Bellonella*, the trunk is soft and fleshy, and the coenenchyme is more or less filled with spicules. In the highly evolved forms, however, the trunk is rather stiff and brittle, and the coenenchyme contains very few or no spicules, in contrast with the outer thick wall closely packed with markedly large spicules, strongly recalling *Siphonogorgia*. These features seem to suggest that the *Siphonogorgia* and allied forms might have been derived from the Alcyoniidae of which the nearest one is *Bellonella*.

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EXPLANATION OF PLATES IX-X

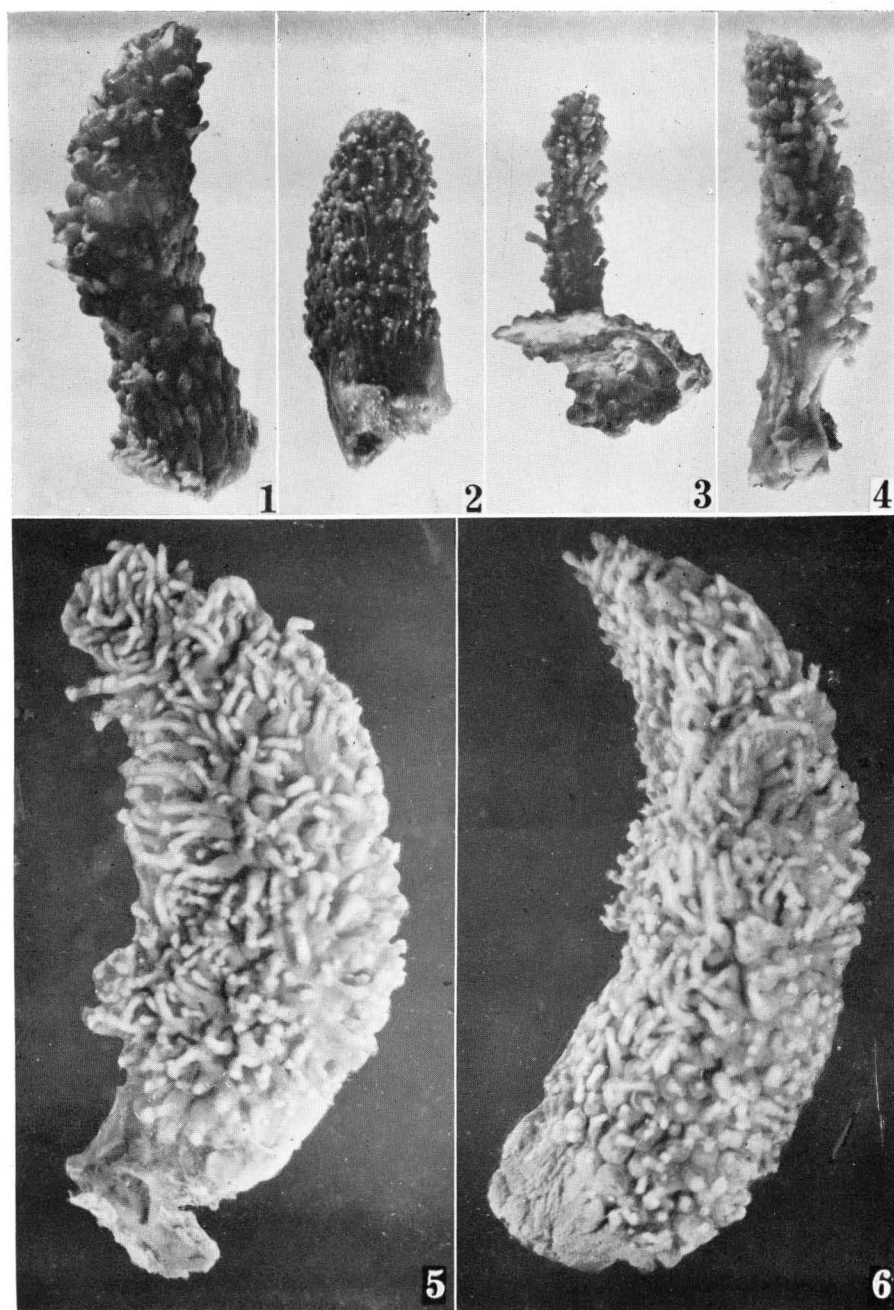
PLATE IX

- Fig. 1. *Bellonella rubra* BRUNDIN, from southeast of Yasiro-zima, Seto Inland Sea.
Fig. 2. *Bellonella rubra* BRUNDIN, from Same-zima, Hayama in Sagami Bay (within I.B.L. No. Coel. 51).
Fig. 3. *Bellonella unicolor* (KÜKENTHAL), from west of Kamegisyô, Sagami Bay (I.B.L. No. Coel. 620).
Fig. 4. *Bellonella unicolor* (KÜKENTHAL), from off Siriyazaki, Tugaru Strait, 180 m.
Fig. 5. *Bellonella grandiflora* (KÜKENTHAL), from Misaki, Sagami Bay (Z.I.K.U.).
Fig. 6. Another specimen of *Bellonella grandiflora* (KÜKENTHAL), from Misaki, Sagami Bay (Z.I.K.U.).

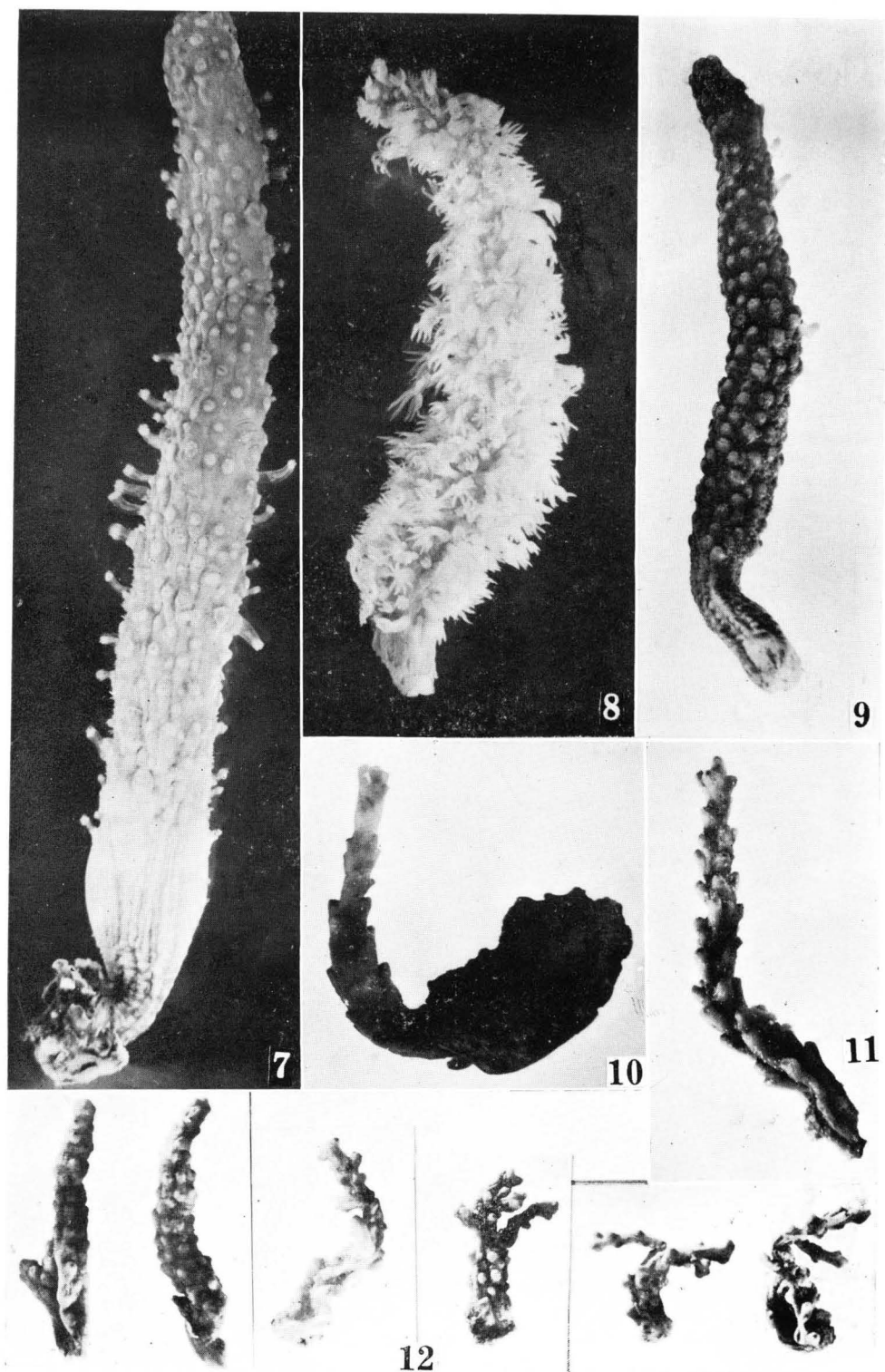
PLATE X

- Fig. 7. *Bellonella pellucida* (KÜKENTHAL), from off Issiki, Sagami Bay (I.B.L. No. Coel. 28).
Fig. 8. *Bellonella albiflora* n. sp., holotype, from west of Kamegisyô, Sagami Bay, 45 m (I.B.L. No. Coel. 632).
Fig. 9. *Bellonella rigida* PÜTTER, from off Hayama, Sagami Bay (I.B.L. No. Coel. 372).
Fig. 10. *Bellonella macrospina* (KÜKENTHAL), from Kadone, off Hayama, 100 m, attached to a shell of *Glycymeris imperialis* (I.B.L. No. Coel. 433).
Fig. 11. *Bellonella sibogae* n. sp., holotype, from off Mimase, Tosa Bay, 100-200 m (S.M.B.L. Type No. 166).
Fig. 12. *Bellonella dofleini* (KÜKENTHAL), from off Mimase, Tosa Bay, 100-200 m. Five branched and one unbranched specimens (S.M.B.L.).

(All photographs in both plates are of natural size.)



H. UTINOMI: ALCYONARIAN GENUS *BELLONELLA* FROM JAPAN.



H. UTINOMI: ALCYONARIAN GENUS *BELLONELLA* FROM JAPAN.